Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

REPRODUCTION BY LAYERING IN THE BLACK SPRUCE

CONTRIBUTIONS FROM THE HULL BOTANICAL LABORATORY 173

GEORGE D. FULLER

(WITH SIX FIGURES)

During the summer of 1912, while making some ecological studies along the Saguenay River, Quebec, attention was directed to the process of forest development upon granitic areas with very little soil, where the rocky surface was exposed to the full sweep of the wind. The most careful studies were made on a series of

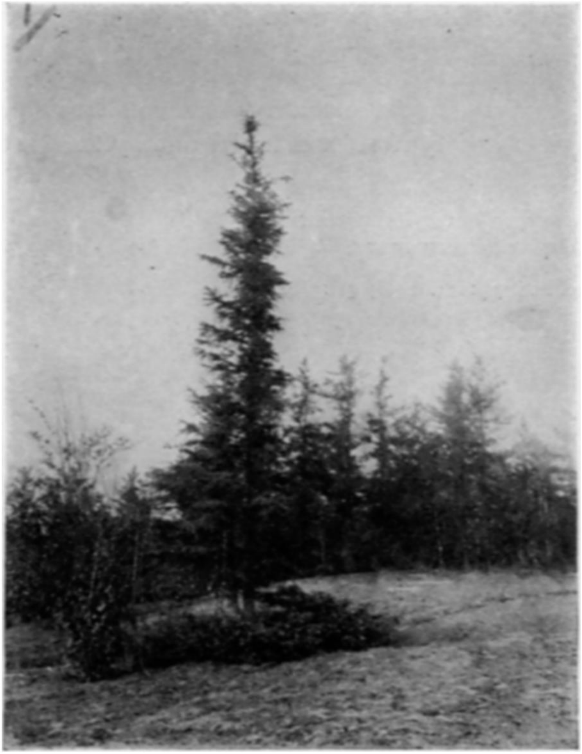

FIG. 1.—The black spruce growing on granite with a basal whorl of prostrate branches; Chicoutimi County, Quebec.

granite hills with typical *roches moutonnées* contours and with elevations varying from 100 to 200 meters, in Chicoutimi County, bordering an arm of the river known as Ha! Ha! Bay. In these exposed situations there occurred a characteristic pioneer forest association consisting, as far as its tree species were concerned, of black spruce (*Picea mariana* Mill. BSP.), Jack pine (*Pinus Banksiana* Lamb.), the white birch (*Betula alba papyrifera* (March.) Spach.), and the aspen (*Populus tremuloides* Michx.), together with occasional trees of a few other species. Because of the slow weathering of these areas, the pioneer stages of forestation were much prolonged, but appeared to be promoted by the development of a peculiar growth habit and a resulting vegetative reproduction by layering. This habit was most highly developed and occurred most frequently in the black spruce.

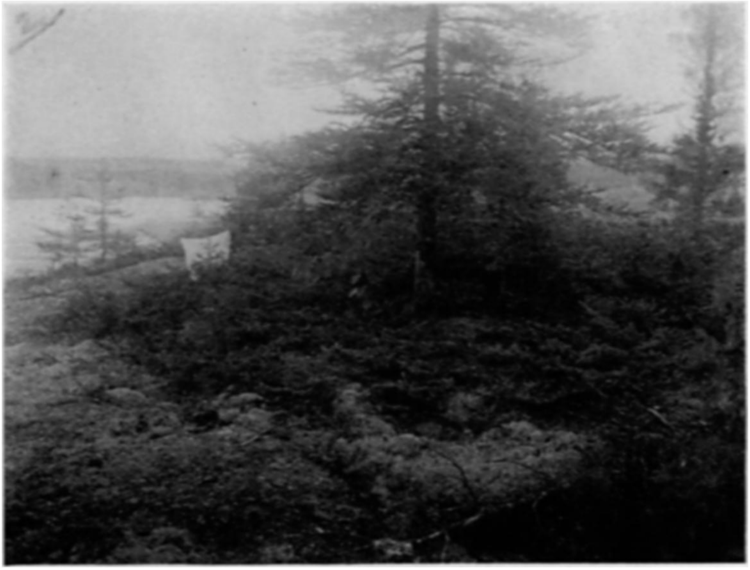

FIG. 2.—The prostrate branches of the black spruce rooting in the mat of mosses and lichens and producing upright shoots; one such shoot has been provided with a white background.

Grown in swamps or thickets the black spruce is characterized by a narrow irregular cone of branches. This cone was found to be even more slender in the sparse stand upon the granite surfaces, but in these open situations there were in addition to the short branches on the upper part of the trunk longer ones near the surface of the rock (figs. 1 and 2), forming a compact mat, none of the twigs more than half a meter high. At least one-half of the total foliage of the trees was usually upon these prostrate branches, and it would seem from the apparent vigor of the leaves that an even larger proportion of the work of food synthesis was to be referred to this lower stratum. The rooting of the trees in these rocky habitats was, as a rule, very shallow, and hence the massing of their branches reduced the exposure to winds and the consequent danger of uprooting. The habit was necessarily confined to open stands.

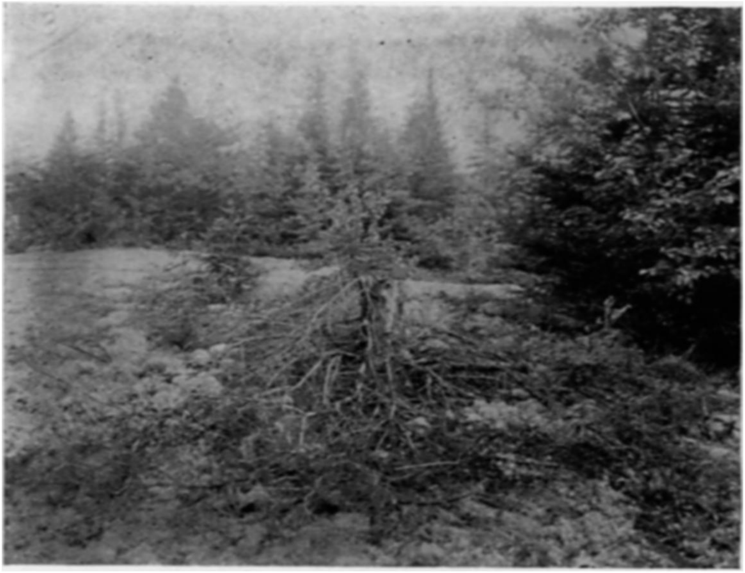

FIG. 3.—A dead stump of black spruce with a circle of living offspring from its layered branches.

The mat of lichens and mosses which antedated the tree continued to thrive under and among the prostrate branches and the resulting soil soon buried portions of the lower members of the mass. On *Pinus Banksiana* this was apparently without results other than

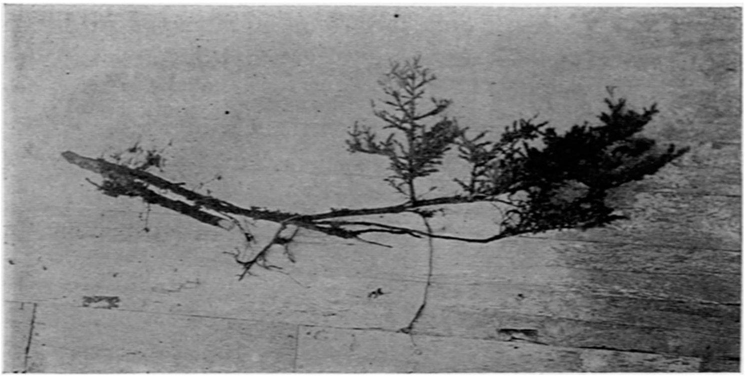

FIG. 4.—A rooted branch of black spruce the result of layering; the upright shoot is the one with the white background in fig. 2.

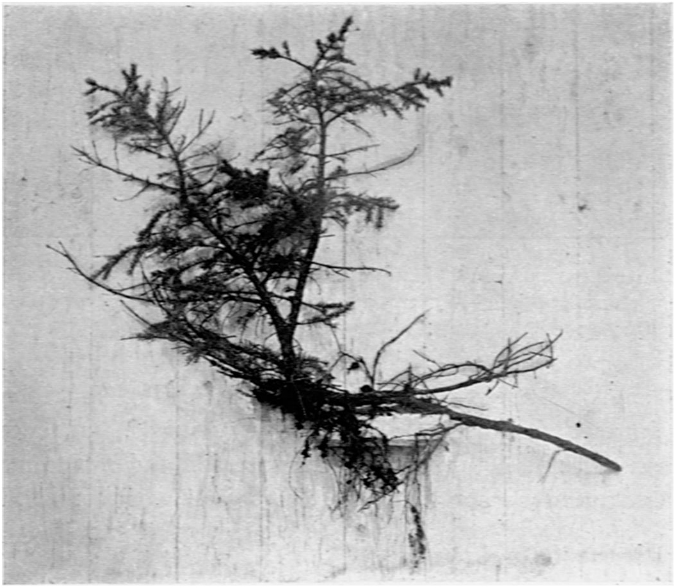

FIG. 5.—A layered branch of black spruce

somewhat more securely anchoring the trees, but on the spruces it often stimulated the production of roots from the buried branches and caused a circle of young trees to surround the parent (fig. 2).

Such reproduction in conifers was recently discussed by COOPER,[1] who also gave very complete citations of the scanty literature of the subject. The layering habit in *Picea mariana* has been mentioned by LOUDON,[2] for specimens growing under partial cultivation on the British Isles, but its importance in increasing the stand upon rocky areas seems to have escaped notice. The fact that the rate of growth has been found to be very slow in such localities[3] makes such a method of rapid multiplication and replacement an even greater advantage to the species possessing it. Should trees

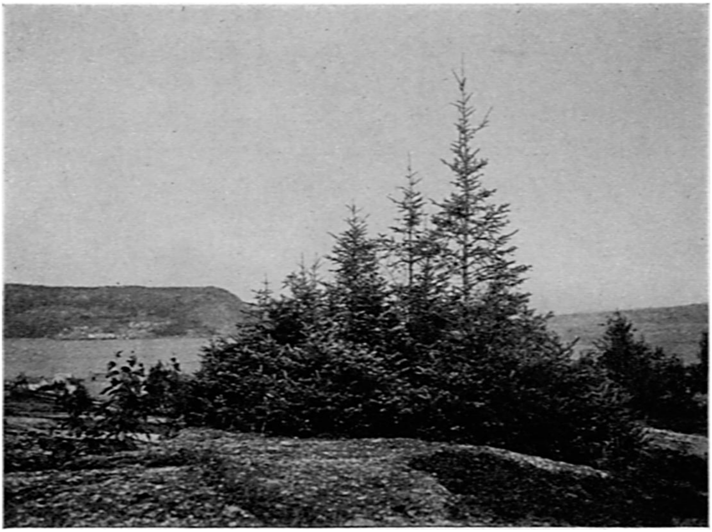

FIG. 6.—A group of young black spruce descended by layering from a single parent tree; the remains of the dead parent are concealed by the young trees; Chicoutimi County, Quebec.

---

[1] COOPER, W. S., Reproduction by layering among conifers. BOT. GAZ. 52:369–379. 1911.

[2] LOUDON, J. C., Arboretum et Fruticetum Britannicum. London. 1844.

[3] COOPER, W. S., The climax forest of Isle Royale, Lake Superior, and its development. II. BOT. GAZ. 55:115–140. 1913.

of the black spruce growing on granite be cut down, their early replacement is much more definitely assured (fig. 3).

By this layering circular areas with a radius of 2–4 meters soon become covered with vigorous young upright shoots, like the one provided with a white background in fig. 2, which is 2.4 meters from the main trunk. This shoot was removed from the soil and proved to be one of two upon a prostrate branch rooted at several points throughout its length (fig. 4). The orthotropic development of the shoot is well marked, while several other twigs showed it in a less marked degree. The development of such shoots seems to be closely connected with the production of adventitious roots, although not always dependent upon it. Occasionally an abundance of adventitious roots was unaccompanied by any definitely orthotropic shoots (fig. 5). This was frequently noticed in the layering of *Abies balsamea* as it occurs in its shrubby habit in the deeper forests.

The layering was seldom found on *Picea canadensis*, because this species rarely occurs in exposed rocky situations as a member of the pioneer forest association. By far the greatest importance of the habit, in the Saguenay region, is its abundance in the black spruce. Often large clumps of small trees could be referred to the parentage of a few individuals, although with increase in size the connections became increasingly difficult to trace. Frequently clusters of 6–20 closely clustered young trees (fig. 6) marked the spot where a tree of a former generation stood, showing much more rapid replacement than could have been effected by seed.

UNIVERSITY OF CHICAGO